Beyond the Earth, the Moon is the only planetary body for which we have data constraining the planetary magnetic field evolution over a long timescale. However, rather than confirming the validity of the models developed for the Earth, the Moon challenges our current understanding. For instance, paleomagnetic data show that the Moon had a dynamo between at least 4.2 and 3.6 Ga, with surface strengths >10 µT, which is ten times larger than the models predictions. The origin and the time evolution of the lunar dynamo field are keys to understanding the deep structure of the Moon and its thermal evolution.

In this thesis, we propose to investigate promising alternative dynamo models, based on the Early Moon precession (Dwyer et al. 2011). Our latest simulations in spheres show that two key deadlocks need to be investigated to assess the relevance of this scenario. First, to be relevant for the Moon, simulations should have a non-zero coupling of the fluid with the mantle in the relevant limit of vanishing viscosity. For numerical reasons, this is not the case in current simulations, performed in spheres, where the coupling is only viscous. To circumvent this issue, we will consider an electrically conducting lowermost mantle: such a non-zero coupling is then obtained while keeping the spectral efficiency of the spherical geometry. Second, boundary driven turbulence prevents the large scale magnetic field to leave the core, leading to a too small surface strength. This effect needs thus to be characterized in order to extrapolate this screening effect to the lunar parameters and obtain accurate predictions. Such a study will have a more general outreach, being relevant for usual thermo-solutal dynamo as the Earth’s one. Indeed, these dynamos can also be screened by precession driven boundary turbulence. Furthermore, it will be relevant for the forthcoming precessing dynamo experiment currently being built in Dresden, that may be affected by a similar screening.

This PhD thesis is directly linked with the general topic “topographic coupling” currently investigated within the group Geodynamo. The PhD student will thus naturally collaborate with other members of the team (e.g. D. Jault).

References